Research Paper Engineering

Compressive Strength Development of Concrete By Using Lateritic Sand as Partial Replacement of Fine Aggregate

Tanveer Asif Zerdi	Director, Professor Head of Civil Engg Dept, KCT Engineering college, Gulbarga, Karnataka, India.
Qizar Ansari	UG Student Department Of Civil Engineering V.T.U University K.C.T.E.C Gulbarga Karnataka
Syed Zeeshan Ali	UG Student Department of Civil Engineering V.T.U University K.C.T.E.C Gulbarga Karnataka
Sayyed Saddam Hussain	UG Student Department of Civil Engineering V.T.U University K.C.T.E.C Gulbarga Karnataka

ABSTRACT

Since availability of river bedded sand is scarce and its utilization is affecting the environment badly, author felt the necessity of finding an alternative to this hence out of motivation this study is taken up. This study investigates the performance of concrete on compressive strength by partially replacing laterite sand available in Humnabad area Bidar District of Karnataka state as a replacement of natural fine aggregate river bedded sand in concrete. The objective of this paper is to examine the strength property of concrete made with laterite. A detailed review of literature related to the scope of this work is presented. The experimental investigation is carried out with laterite available in Humnabad Taluk, Bidar District. The Shahpur sand which is the river bedded sand was replaced with laterite at the rate of 0%, 10%, 20%, 30% by weight for design mix of M20 controlled concrete. A total of 48 specimens of size 150mm x 150mm x 150mm are prepared to determine the cube compressive strength after 3,7,21 and 28 days of curing. From the studies, addition of laterite reduces workability in concrete. Compressive strength decreases with increase in percentage of laterite replacement with sand. Lateritic sand replacement at the percentage of 20% giving the optimum strength, but still it is lesser than the normal concrete mix. From the results authors are of the opinion that lateritic sand which is available cheaply can be a best alternative to river bedded shahpur sand of Gulbarga area.

KEYWORDS laterite sand, Shahpur sand, Coarse aggregate, replacement, Concrete.

Introduction

Concrete is most widely used as manmade construction material in the world. Concrete is so closely related with every construction activity that it touches every human being in his day to day living. It is obtained by mixing cementations materials, water and aggregate and sometimes admixtures in required proportions if needed. Concrete does not solidify from drying after mixing and placement; the water reacts with the cement in a chemical process known as hydration. The mixtures when placed in forms are allowed to cure and harden into a rock like mass known as concrete. Fine aggregate is generally natural sand and is graded from particle size of 4.75mm down to 70 micron. The concrete grows stronger with age. The strength, durability and other characteristics of the concrete depend upon the properties of its ingredients, on the proportions of mix, the method of compaction and other controls during placing, compaction and curing. The supply of sand is being threatened by a number of factors on one hand while its demand is increasing at alarming rate on the other hand. Increasing environmental consideration are among other factors besides being the only conventional fine aggregate that militate against supply of sand.It has been observed that based on the availability of laterite, a fine aggregate, laterite could either partially or wholly replace sand as fine aggregate. The criterion for concrete strength requirement is always based on the characteristic compressive strength obtained after 28-day curing. The compression strength of concrete is usually determined by performing compression test on standard sizes of concrete blocks (i.e., 150mm x 150mm x 150mm). The strength of concrete is affected partly by the relative proportion of cement and of the fine and coarse aggregates but the water-cement ratio is another important factor. There is an optimum amount of water that will produce a concrete of maximum strength from a particular mix of fine and coarse aggregate and cement. The ease of working with the concrete (i.e. workability) also depends on the quality of water used. The use of less than the optimum amount of water may make setting difficult and reduce workability. On the other hand, greater shrinkage and a reduction in strength will occur when more water than the optimum amount is used.

LITERATURE RIVIEW

The shortage of building materials coupled with the continuous increase in cost of procuring them are just two out of all the factors responsible for the current acute shortfall in the provision of adequate housing. Therefore the need for a research work aimed at reviewing the use of these materials or providing and finding alternative materials, but which are relatively cheap and available cannot be overemphasized. This effort would go a long way in alleviating the problem of shelter provision confirming the teeming population, especially of developing countries. To this end, intensive investigations have been on to develop and establish engineering basis for the use of lateritic soils, which are abundantly available, as substitute of aggregates in construction works, most especially concreting. In the light of this, studies that determine the proportions of concrete components that give optimum strength characteristics have been carried out. Most of the studies focused on stabilization of laterite with the addition of lime, cement etc. Some of the study concentrated on the improving the strength of laterite as sub grade in road and pavement construction. A very few studies were carried out of

using laterite as a substitute for the fine aggregate in concrete and structural importance of laterite replaced concrete. Due to this, there have not been accepted standards as regards their performance such as strength and durability. From the findings of this research, lateritic concrete is less workable compared to the normal concrete. Laterite form a group comprising a wide variety of red and brown, fine grained residual soils of light texture as well as nodular gravels. They may vary from a loose material to a massive rock.The research work regarding the use of laterite in concrete is very rare in India and data available in this is very limited till date even though laterite is readily available in Humnabad region of Bidar District.

OBJECTIVES.

1.The objective of this study is to determine the compressive strength of concrete by partially replacing Shahpur Sand with Laterite sand at 10%,20%, 30% and curing the concrete for3,7,21,28 days of curing.

2. Preparing the normal concrete by utilising normal best quality river bedded sand of this area that is shahpur sand and ascertaining its compressive strength at 3,7,21,28 days of curing.

3. Comparing the compressive strength development of above two types of concretes and ascertaining the feasibility of using laterite sand.

EXPERIMENTAL INVESTIGATION

Overall Scheme of Experimental Investigation

The parameters considered for the study are the workability, cube compressive strength. The mix proportion for M20 concrete designed as per provisions in IS Codes

were considered for this investigation. Laterite of proportions 10%,20%, 30% of weight of sand were used to make

corresponding concrete. 18 cubes (150mm x 150mm x 150mm) were tested in this investigation.

Materials Used

Pozzolana Portland cement 53 grade, locally available good quality Shahpur sand of specific gravity 2.59 passing through 4.75mm IS sieve conforming to zone II , coarse aggregate of specific gravity 2.73, laterite of specific gravity 2.68 and fineness modulus 2.73 and Potable water were used for making the various concrete mixes considered in this study.

Mix Design

M20 concrete mix was designed as per IS

10262:2009. The mix obtained as per IS code design is of proportion 1: 2: 3.3: 0.55. The quantity required for 1m^3 concrete as given in Table 1. For all replacement level, the same mix ratio for normal concrete followed. In this investigation, the % of replacement of laterite made without effecting W/C ratio and mix proportion.

Preparation of Test Specimen.

Hand mixing is done. Slump test was conducted for each mix to assess the workability. Concrete cubes (150mm) for determining compressive strength. Specimens were demoulded after 24 hours of casting and were kept in a curing tank for water curing for next 28 days.

Table-1. Quantity required for 1m^3 concrete

Sl. No.	% of Laterite sand	Cement Kg/m^3	Fine aggregate Kg/m^3		Coarse Aggregate kg/m^3	Water Kg/m^3
			sand	laterite		
1	0%	361.78	745.18	0.00	1187.851	198.97
2	10%	361.78	670.66	74.51	1187.851	198.97
3	20%	361.78	596.14	149.4	1187.851	198.97
4	30%	361.78	521.62	223.5	1187.85	198.97

Analysis of Experimental Results

Properties of Fresh Concrete

Fresh concrete or plastic concrete is freshly mixed material, which can be moulded into any shape. The relative quantities of cement, coarse aggregate, fine aggregate and water mixed together, control the concrete properties in the fresh state. Workability of concrete was determined by conducting slump test. Test results are tabulated in

Table 2.

Table 2- Variation in workability

Mix	% Replacement of Fine Aggregates	Slump (mm)
F0	0	100
F10	10	85
F20	20	75
F30	30	55

Cube Compressive Strength.

Compression test of cubes is the most common test conducted on hardened concrete partly because it is an easy test to perform and partly because most of the desirable properties of concrete are comparatively related to its compressive strength. For each mix of ordinary concrete and concrete with varying percentage of laterite, three cube specimens each of size 150mm×150mm×150mm were tested, on the 3rd, 7th, 21st and 28th day of curing and the average values obtained are given in Tables 3.

Table 3- Cube Compressive Strength for various mixes of M20 Grade concrete

Mix	%age laterite	3 days	7 days	21 days	28 days
F0	0	10.64	18.24	23.06	26.50
F10	10	8.17	15.87	20.12	22.14
F20	20	8.977	17.51	22.32	24.52
F30	30	9.24	16.94	21.04	22.96

Test results shows that the addition of laterite to ordinary concrete is found to reduce the compressive strength.

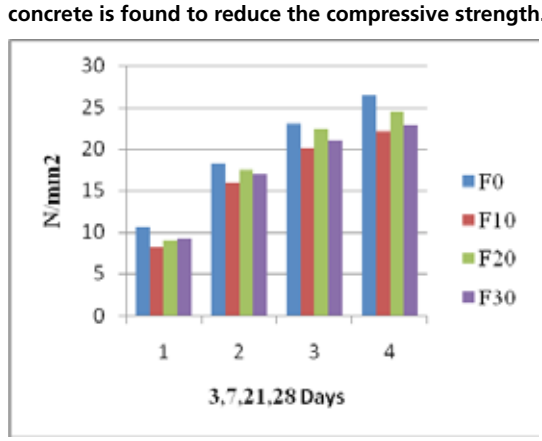

Fig.1Comparison of 3,7,21, and 28 Days Compressive Strength of Ordinary Concrete and concrete with varying percentage.

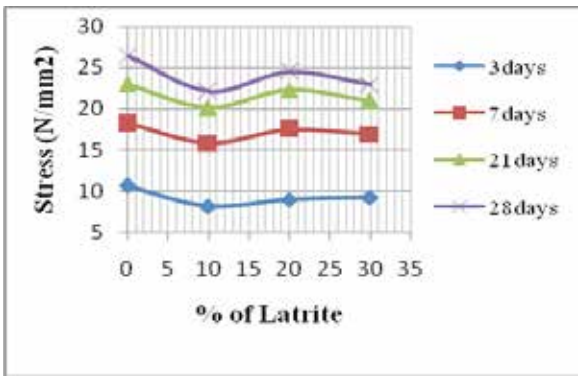

Fig. 2 Variation of compressive strength of concrete cube

CONCLUSION

From the experimental investigation, the following conclusions are arrived at

1. The development of compressive strength for normal mix concrete is giving the 10.64, 18.24, 23.06, 26.50 N/mm^2 at 3,7,21, and 28 days of curing respectively.

2. Similarly the compressive strength of laterite replaced concrete is giving 22.14,24.52,22.96 N/mm^2 at 10,20,30 percentage replacement of laterite respectively.

3. if we compare the values of the two types of concretes studied shows that the incorporation of laterite sand by replacing normal shahpur sand is decreasing the compressive strength of concrete, but this decreament is not very large, hence authors feel that the replacement of laterite sand is a break through to the prevailing crisis of availability of river bedded sand. Hence authors recommends to utilize laterite sand in the manufacturing the concrete.

4. Introduction of laterite content into the concrete matrix is found to reduce the workability of the mix. This is due to finesse of laterite which ultimately increases the total surface area of concrete and consequently, more water is required to wet the surface of aggregate.

5. Addition of laterite to any particular concrete mix is found to reduce its compressive strength. This is due to finesse of laterite which ultimately increase the air voids as fine particle is at the bottom side and air voids at the top level do not fill properly.

6. Laterite content of 20% by weight of sand content has shown the best results. Thus indicating the possibility of using laterite as a partial replacement for sand.

Reference

[1] Biju Mathew, Dr. Benny Joseph, Dr. C Freeda Christy. (2013) Strength Performance of Concrete using Laterite as Sand Replacement. International Journal of Civil Engineering Research and Applications Vol. 1, Issue 3, August -2013. P. 38-42

[2] Festus Adeyemi Olutoge, Kikelomo Mulikat Adeniran, Oluwatobi Brian Oyegbile (2013).The Ultimate Strenght Behaviour of Laterized Concrete Beam. Science Research 2013; 1(3): 52-58. DOi: 10.11648/j.sr.20130103.14, July 2013.

[3] G. Sabarish, M.K.M.V. Ratnam, Dr. A.C.S.V. Prasad, Dr. U. Ranga Raju (2015). A Study on Strenght and Durability Characteristics of Concrete with Partial Replacement of Fine Aggregate by Lateritic Sand. IJIRST- International Journal for Innovative Research in Science & Technology. Vol. 02| Issue 03| August 2015. ISSN: 2349-6010. P. 134-141.

[4] Omotola Alawode, P.G. Dip, & O.I. Idowu. M.Sc.(2011). Effects of Water-Cement Ratios on the Compressive Strenght and Workability of Concrete and Lateritic Concrete Mixes.The Pacific Journal of Science and Technology, Vol. 12, Number 2. November 2011. P. 99-105.

[5] Shuaibu R.A, Mutuku R.N, Nyomboi T, (2014). A Review of the Properties of Laterite Concrete. International Journal of Civil and Structural Engineering, Vol. 05, No 2, Issue 2, 2014. ISSN: 0976-4399. P. 130-143.